Freshwater inflow and sediment and nutrient loading from Trinity River to Galveston Bay

October 31, 2018

U.S. Geological Survey

Texas Water Science Center

Gulf Coast Program Office

Texas Water Development Board

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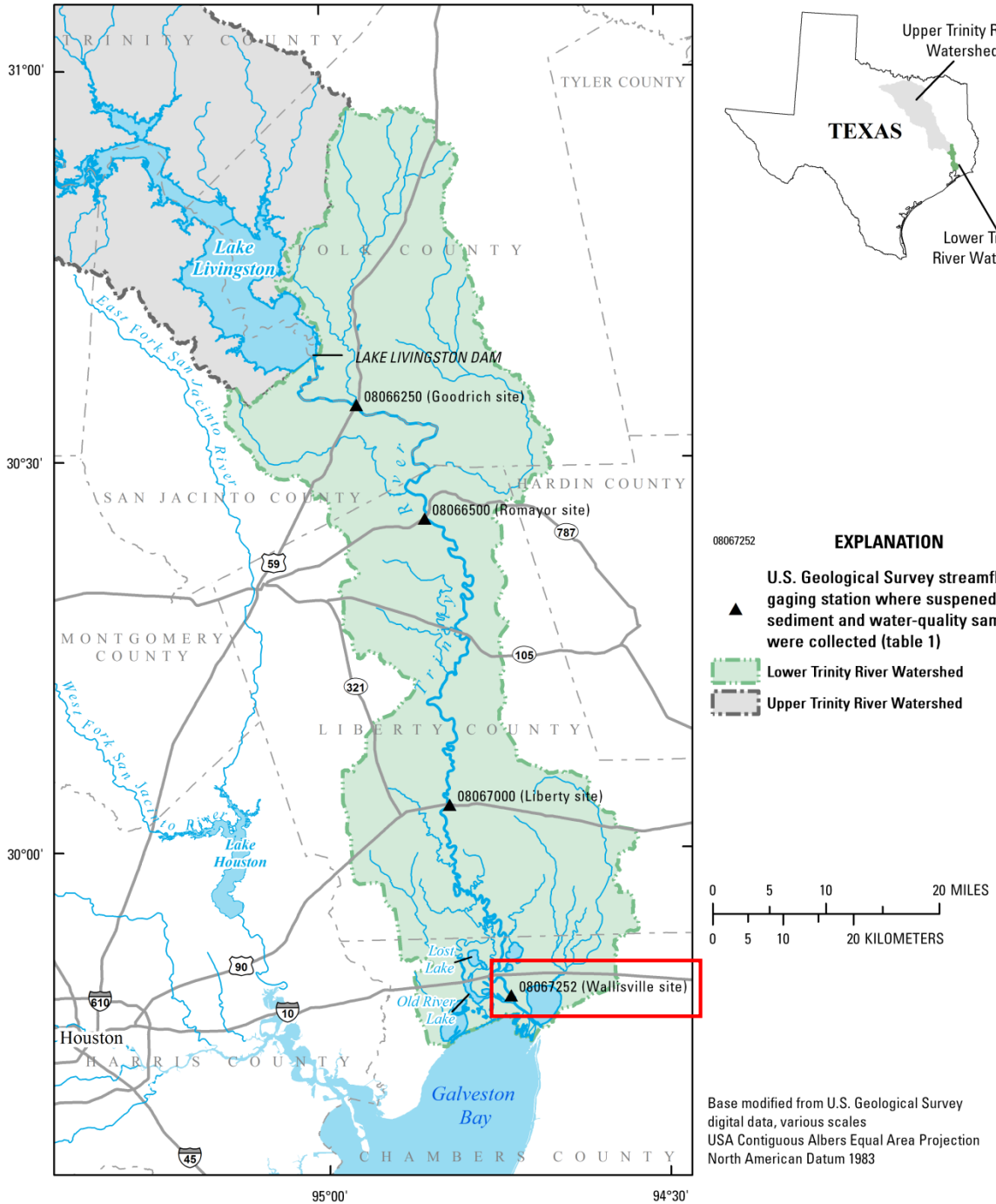
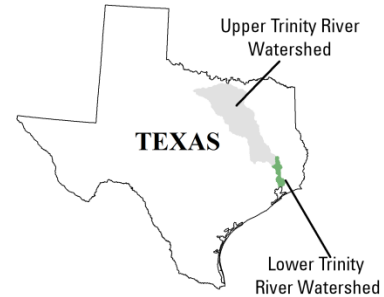
USGS Studies

- Monitoring lower reaches of multiple rivers in the Texas coast since 2009

- Studies have been conducted to:
  - Quantify freshwater inflow to bays and estuaries
  - Characterize quality of inflows
    - Nutrients
    - Sediment


Austin
The Woodlands
Beaumont
San Marcos
Trinity River
New Braunfels
Houston
San Jacinto River
Sugar Land
Rosenberg
San Antonio
Texas City
Galveston
Lake Jackson
Bay City
Victoria
Colorado River
Guadalupe River
Gulf of Mexico
Nueces River
Corpus Christi





08067252

EXPLANATION

▲ U.S. Geological Survey streamflow-gaging station where suspened-sediment and water-quality samples were collected (table 1)

Lower Trinity River Watershed

Upper Trinity River Watershed

0 5 10 20 MILES

0 5 10 20 KILOMETERS

Base modified from U.S. Geological Survey digital data, various scales
USA Contiguous Albers Equal Area Projection
North American Datum 1983

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PROJECT TASKS

Main task: *Analysis of streamflow and nutrient and sediment concentrations in inflows to Galveston Bay from the lower Trinity River*

1. Operation and maintenance of index-velocity streamgage at Trinity River at Wallisville, TX and periodic water-quality sample collection for maintenance of a sediment surrogate.
2. Streamflow measurements and water-quality sample collection at Old River and Wallisville site during high flows.
3. Examine streamflow and water-quality from Lake Livingston to the lower portions of the watershed.

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Task 1: Index-Velocity Streamgage

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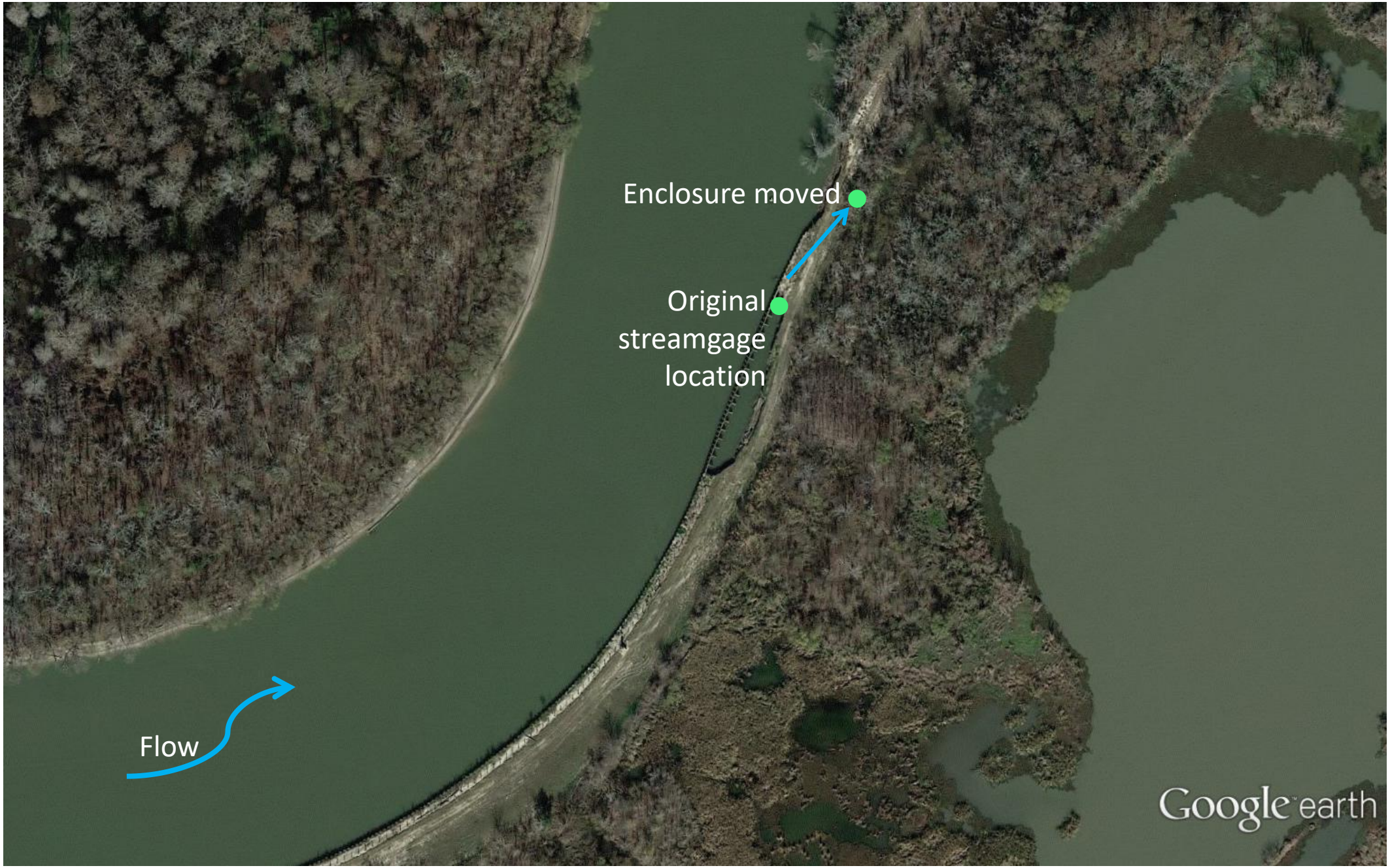
Enclosure moved
Original streamgage location
Flow
Google earth

Task 1: Index-Velocity Streamgage

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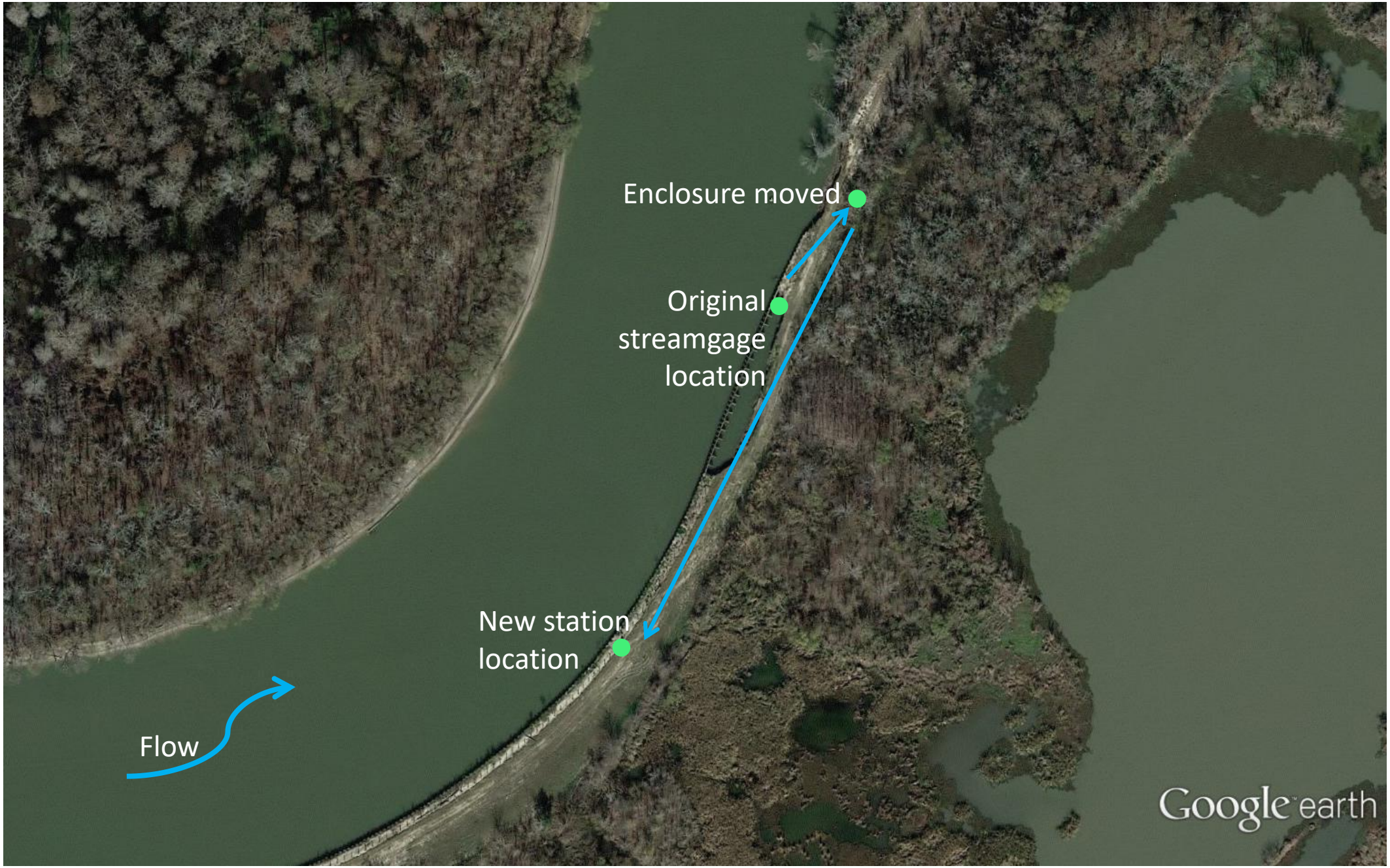
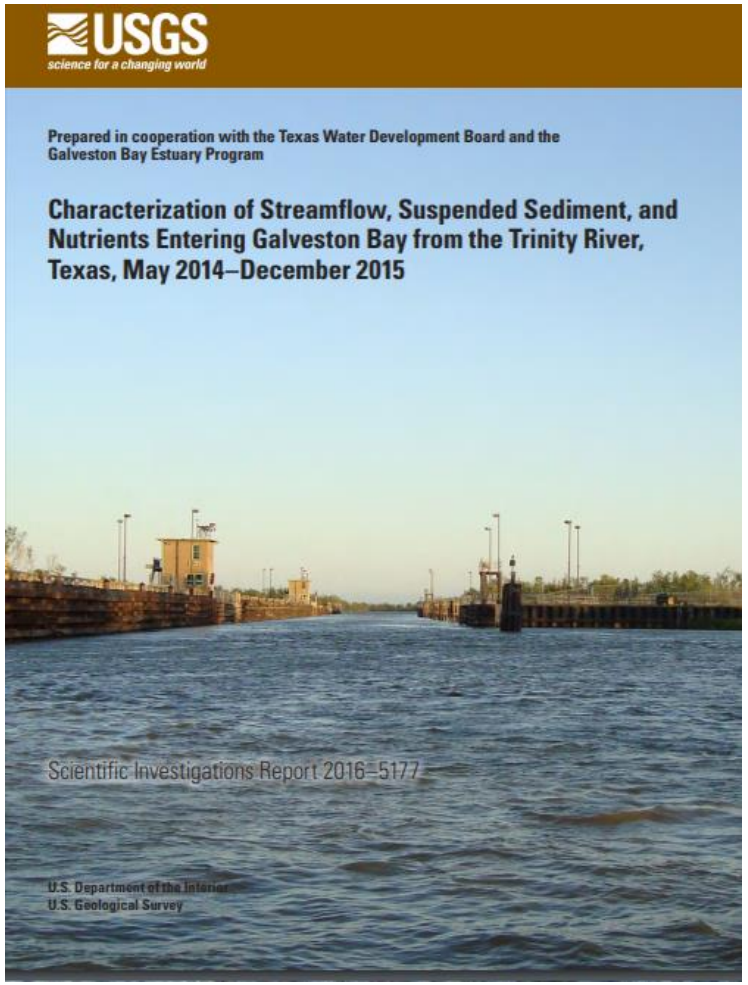

Enclosure moved
Original streamgage location
New station location
Flow
Google earth

Sediment Surrogate

- The ADVM installed to compute streamflow is also used to estimate suspended sediment concentration at 15-minute intervals, providing a continuous record of suspended sediment loading in the lower Trinity River
- USGS collected samples to maintain and verify the surrogate model developed for this station
- Real-time data will be available on NWIS Web



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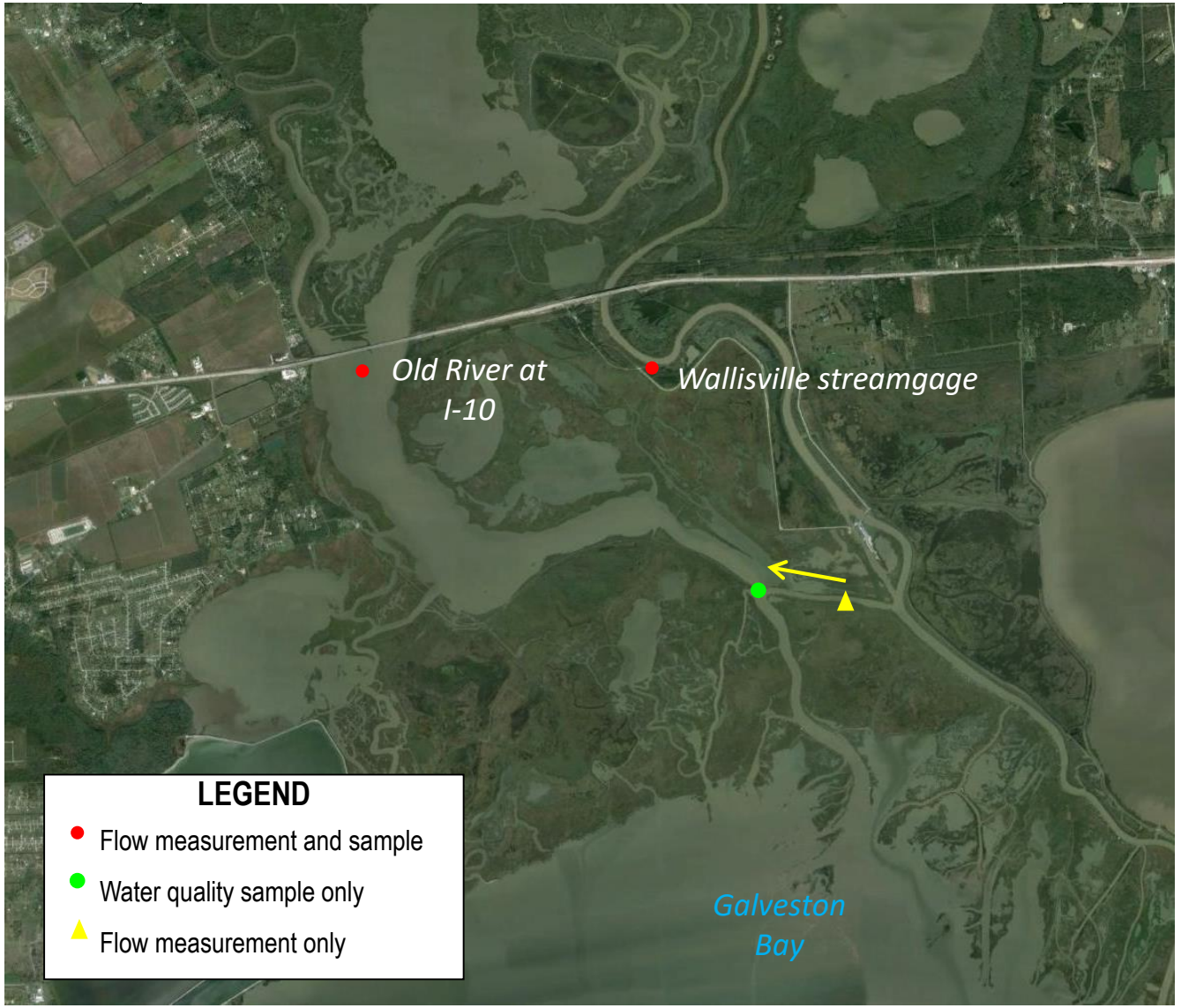
Task 2: High Flow Streamflow and Water Quality



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Event Streamflow Summary

Streamflow (in cubic feet per second) measured at:

Date	Trinity River at Liberty	Trinity River at Wallisville	Old River Lake	Wallisville + Old River	Difference in streamflow	Percent difference
6/10/2015	60,000	21,600	44,300	65,900	5,900	9.8
3/17/2016	52,000	22,700	34,800	57,500	5,500	10.6
4/26/2016	32,000	17,200	7,360	24,600	-7,400	-23.1
6/3/2016	81,000	22,300	62,700	85,000	4,000	4.9
9/2/2017	125,000	38,500	96,200	134,700	9,700	7.8
3/1/2018	34,000	18,400	13,300	31,700	-2,300	-6.8
4/4/2018	65,000	21,400	37,800	61,200	-3,800	-5.8
10/22/2018	60,000	21, 900	35,900	57,800	-2,200	-3.7
					Average	**-0.8**

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Streamflow Summary

- During events, the majority of the water travels to Galveston Bay through Old River and surrounding wetlands

- USGS Station Trinity River at Liberty may be a good indicator of the volume of water received by Galveston Bay, but does not provide information on:
  - Timing and residence times
  - Potential storage in Old River
  - Possible changes in concentrations of water quality constituents

Streamflow Effects on Water Quality

As water flows through wetlands the concentration of water quality constituents may change:

- *Decrease in concentrations:* Settling of suspended particles, denitrification, vegetation uptake, and retention

- *Increase in concentrations:* Input from wetland vegetation and biota

These changes may ultimately affect nutrient and sediment loading to Galveston Bay.

Water Quality Constituents Measured

- Suspended-sediment
- Nutrients
  - Ammonia
  - Nitrate
  - Nitrite
  - Total nitrogen
  - Total organic carbon
  - Dissolved organic carbon
- Physical properties
  - Temperature
  - pH
  - Dissolved oxygen concentration
  - Turbidity
  - Specific conductance

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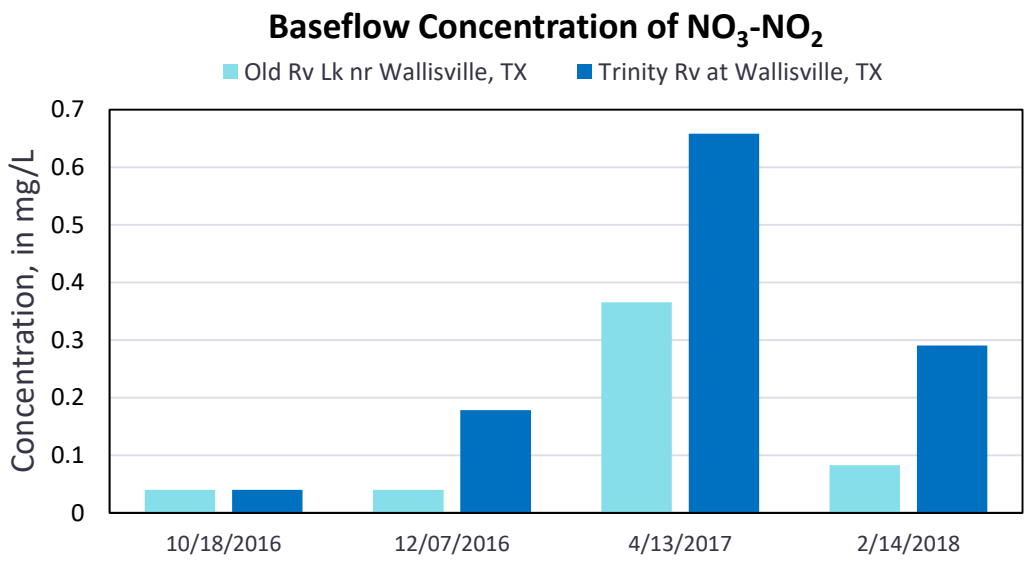
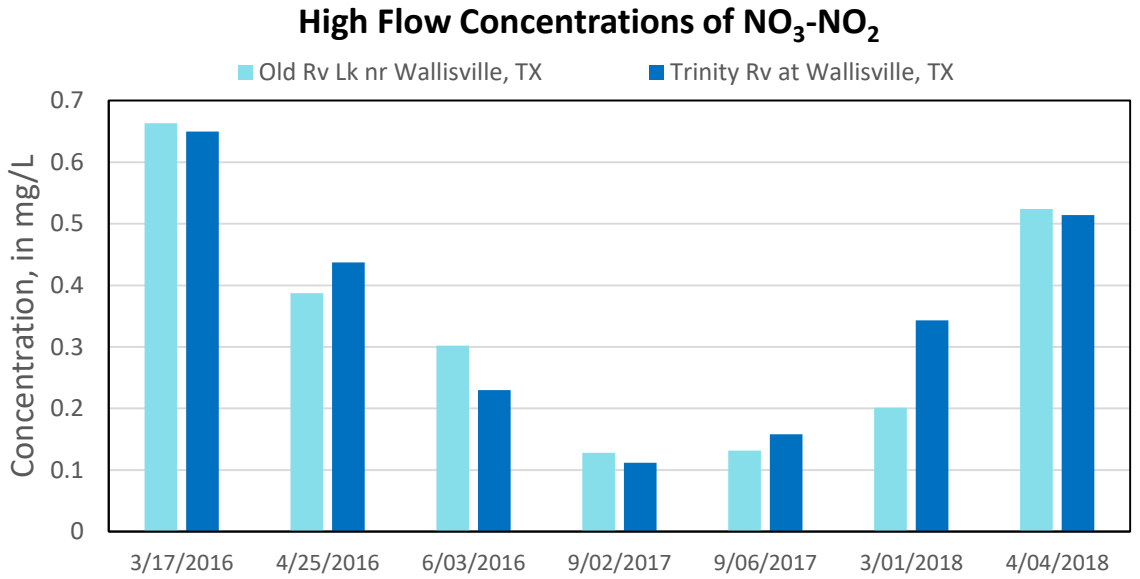
Nitrate Plus Nitrite Concentrations





Data suggests that longer residence times in Old River during baseflow may promote biogeochemical transformation of dissolved nitrate.

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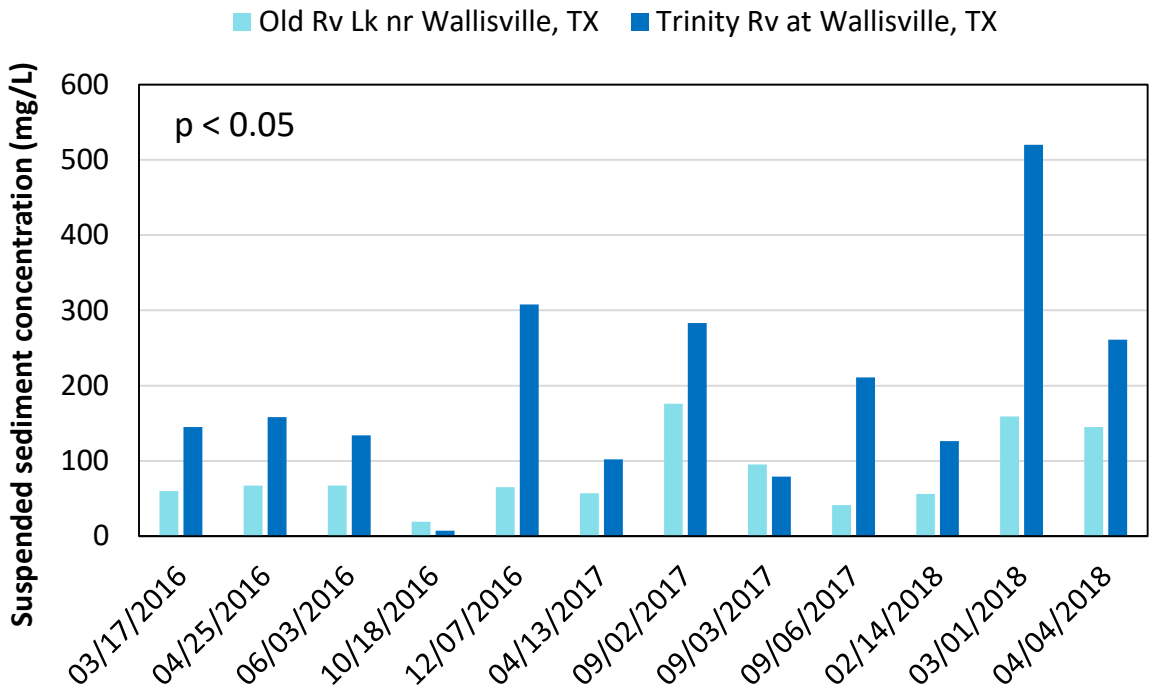
Suspended Sediment Concentrations



Summary statistics for suspended sediment concentration in mg/L

	Old River	Trinity
Min	19	7
Mean	84	195
Max	176	520

Because the majority of the streamflow travels through Old River during events and the concentrations between sites are significantly different, we cannot consider the concentrations measured in the main channel of the Trinity to be representative of sediment concentrations in inflow to Galveston Bay.

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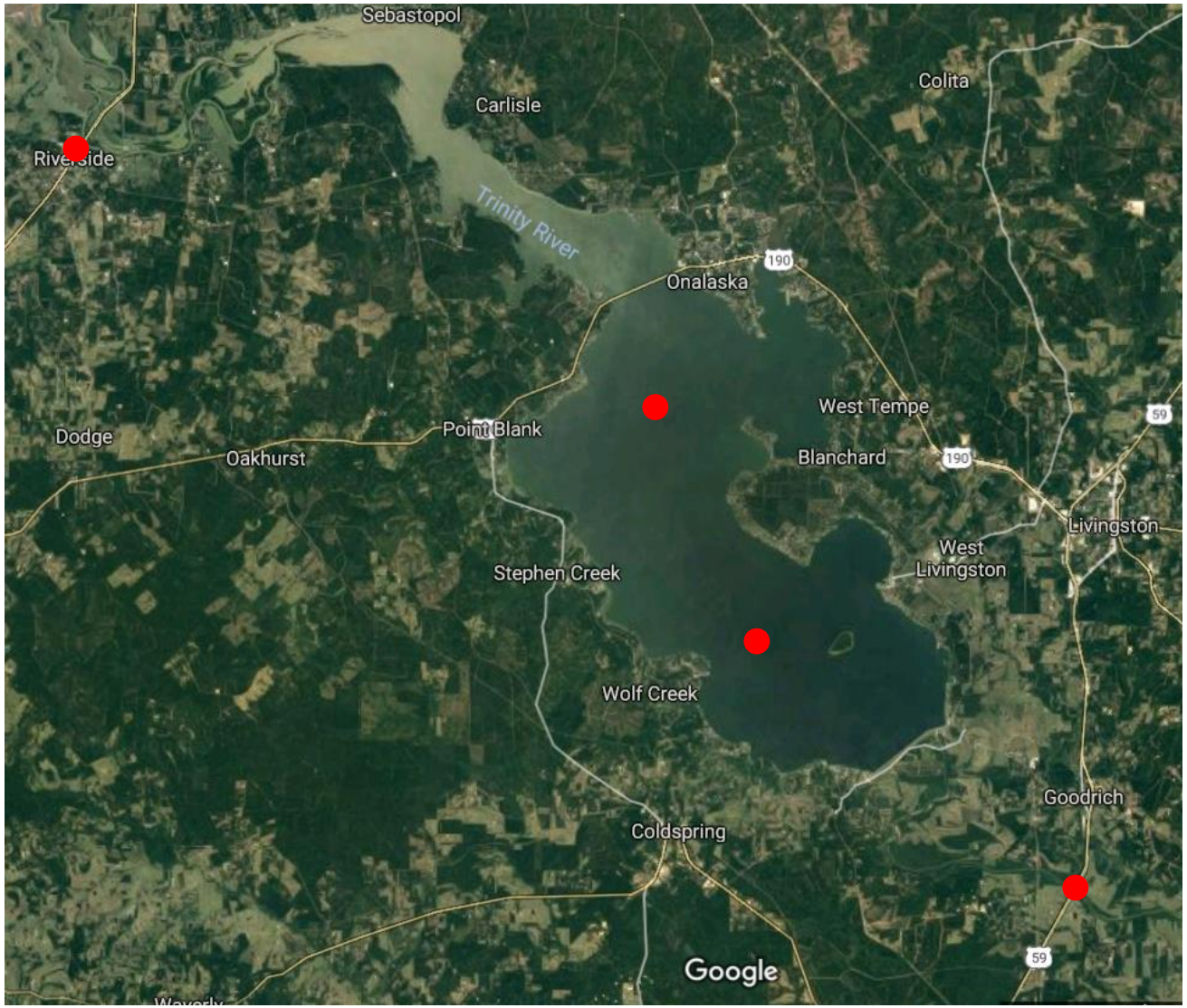
Task 3: Watershed Analysis



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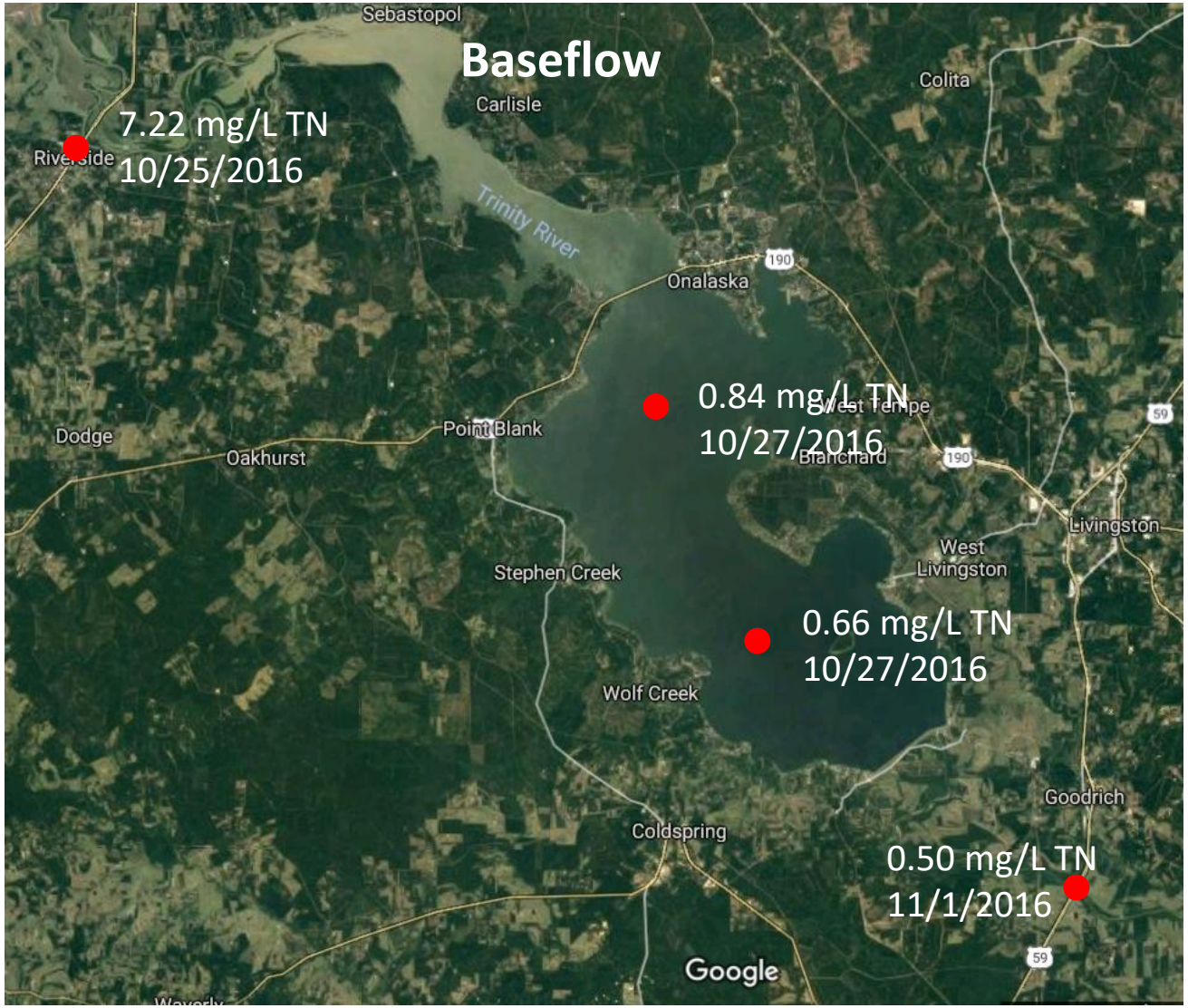

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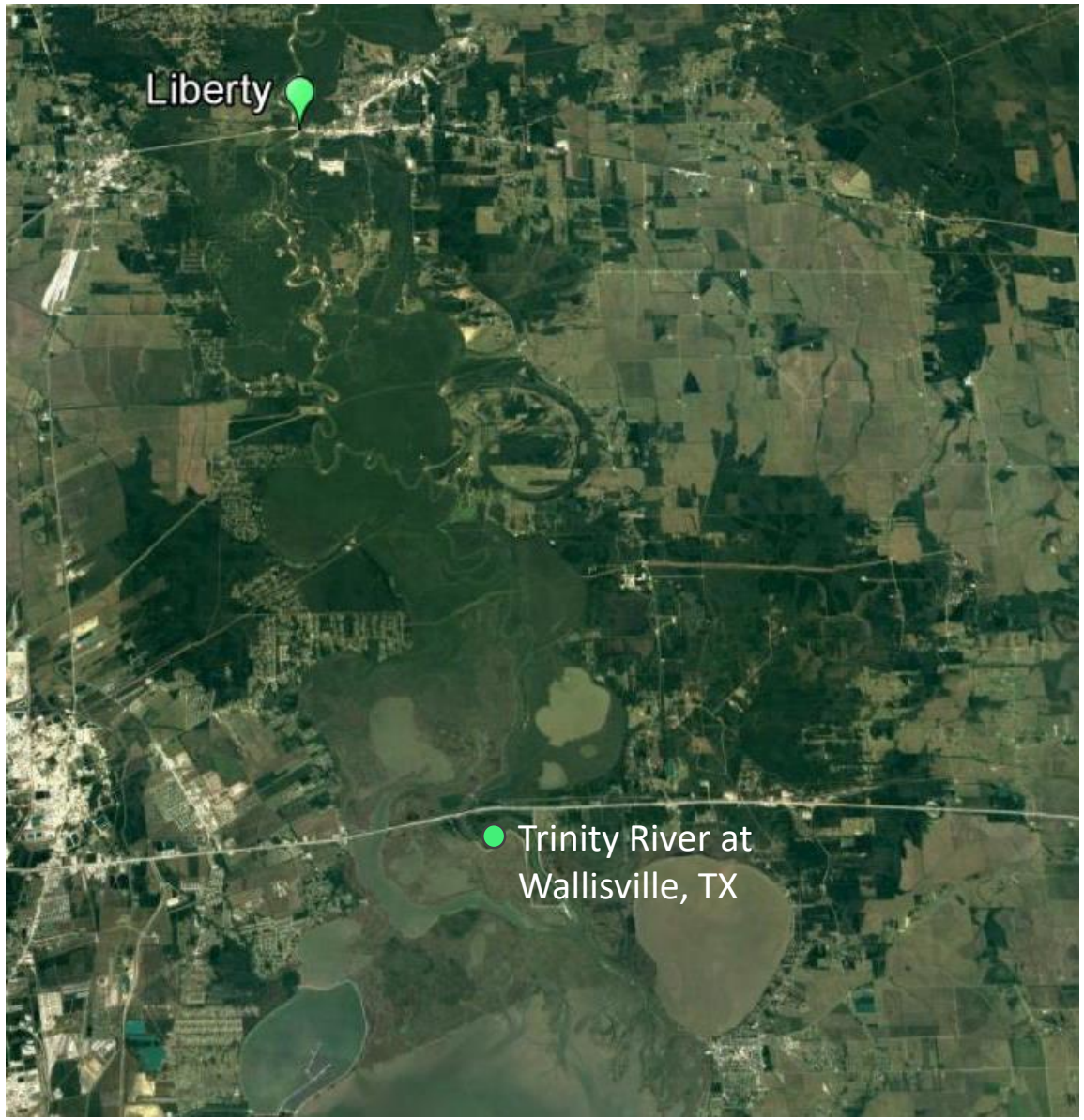

Total Nitrogen Concentrations (mg/L)

Date	Liberty	Wallisville
Mar-2015	1.38	1.25
Jun-2016	0.90	0.82
Aug-2017	0.74	0.67
Apr-2018	1.18	1.13
Oct-2018	Pending	Pending

Suspended Sediment Concentrations (mg/L)

Date	Liberty	Wallisville
Mar-2015	200	145
Jun-2016	350	134
Aug-2017	204	283
Apr-2018	550	261
Oct-2018	Pending	Pending

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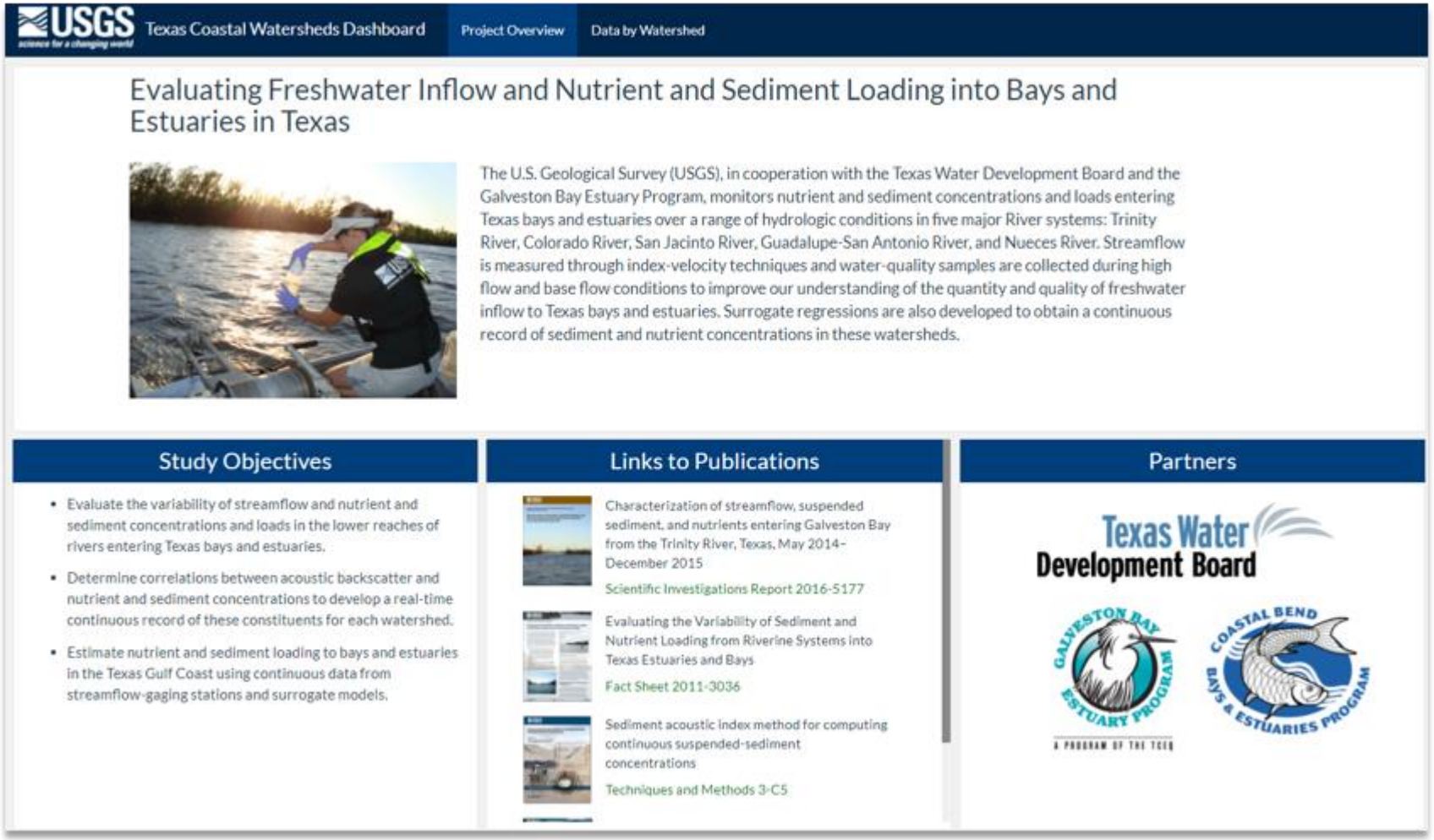
Where to get the Data



https://zlucena.shinyapps.io/CoastalDashboard/

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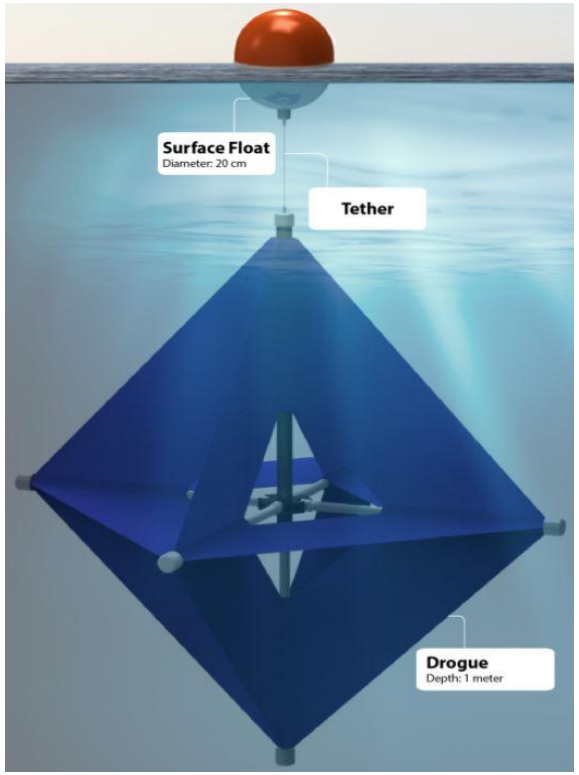
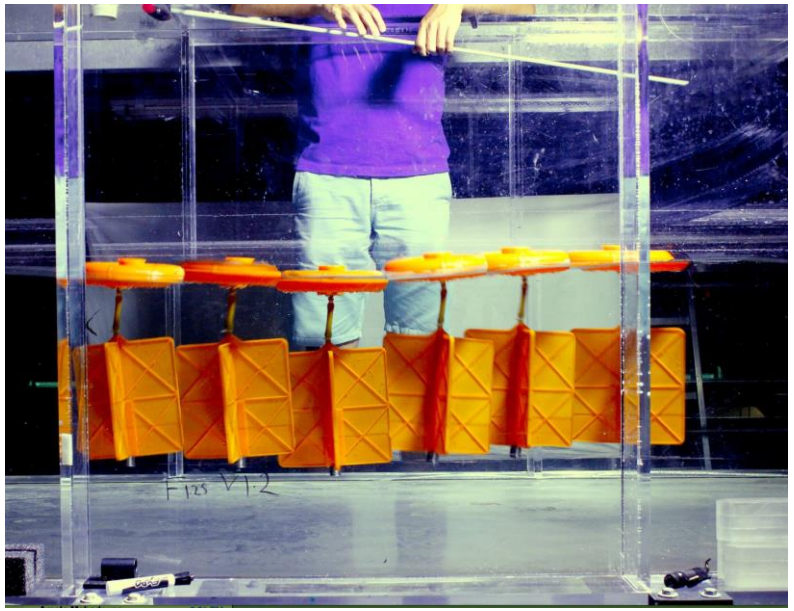
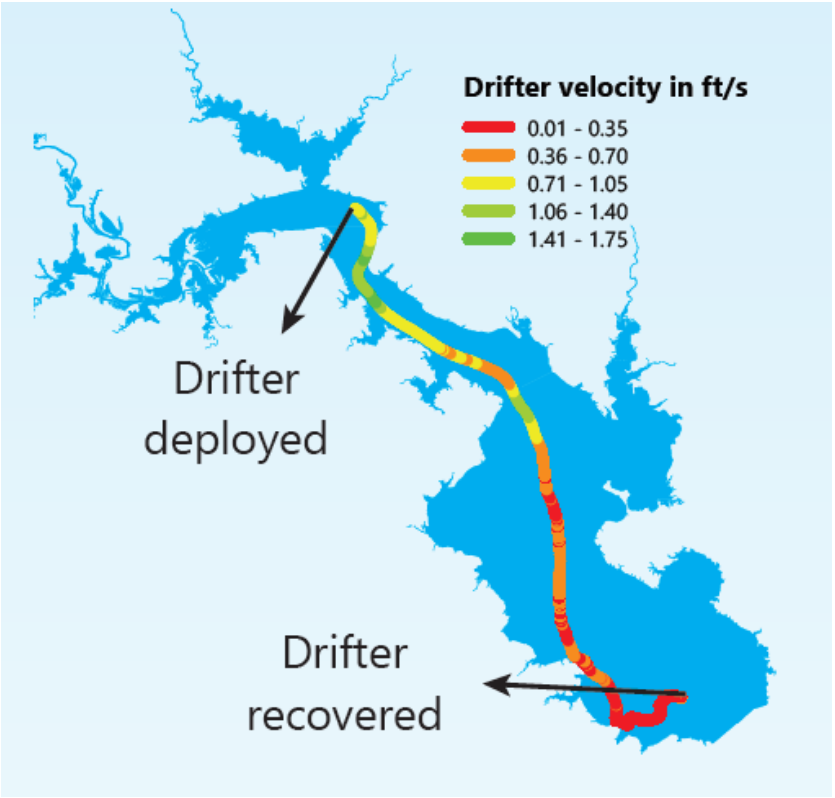
Next Steps

- Collection of nitrogen and oxygen isotopes samples as a tool for source identification
- Assess feasibility of applying a surrogate method to estimate real-time suspended-sediment concentration and loads in Old River
- Assess upper and lower end of Old River to better understand settling
- Evaluate groundwater contributions
- Write report documenting streamflow patterns in the watershed and effects on water quality
- GPS drifter studies to understand residence time in the lower reaches of the trinity River watershed

GPS Drifters







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City of Houston Texas

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Texas Coastal Watersheds Dashboard

Project Overview | Data by Watershed

Select Watershed

Trinity River

Select Date Range for Water Quality Data

2013-01-01 to 2018-10-30

Download

Links to Available Real-Time Data:

- Trinity River
- Guadalupe River
- Colorado River

Watershed Data Table

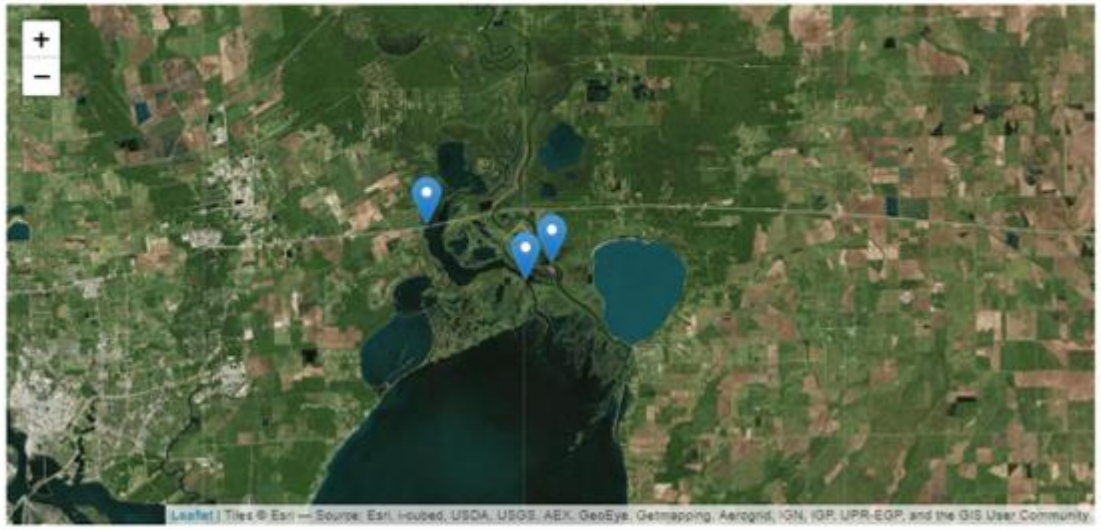
Show 15 entries Search:

Station Number	Station Name	Basin	Sample Date	Sample Time	Stream flow, instantaneou
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-04-25	12:13	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-05-13	12:16	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-05-14	12:00	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-06-06	12:15	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-08-13	13:12	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-10-24	12:40	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-11-07	12:45	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2013-12-03	12:40	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-01-15	11:10	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-01-29	11:45	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-02-21	12:30	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-03-11	11:41	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-03-28	12:15	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-04-22	12:22	
08067252	Trinity Rv at Wallisville, TX	Trinity River	2014-05-16	11:35	

Showing 1 to 15 of 88 entries

Previous 1 2 3 4 5 6 Next

Station Map



14-day Hydrograph